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Playing jigsaw with large igneous provinces – a plate-tectonic reconstruction of Ontong Java Nui

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Ontong Java Nui is a Cretaceous large igneous province (LIP), which was rifted apart into various smaller plateaus shortly after its emplacement around 125 Ma in the central Pacific. It incorporated the Ontong Java Plateau, the Hikurangi Plateau and the Manihiki Plateau as well as multiple smaller fragments, which have been subducted. Its size has been estimated to be approximately 0.8% of the Earth's surface. A volcanic edifice of this size has potentially had a great impact on the environment such as its CO₂ release. The break-up of the "Super"-LIP is poorly constrained, because the break-up and subsequent seafloor spreading occurred within the Cretaceous Quiet Period. The Manihiki Plateau is presumably the centerpiece of this "Super"-LIP and shows by its margins and internal fragmentation that its tectonic and volcanic activity is related to the break-up of Ontong Java Nui.

By incorporating two new seismic refraction/wide-angle reflection lines across two of the main sub-plateaus of the Manihiki Plateau, we can classify the break-up modes of the individual margins of the Manihiki Plateau. The Western Plateaus experienced crustal stretching due to the westward motion of the Ontong Java Plateau. The High Plateau shows sharp strike-slip movements at its eastern boundary towards an earlier part of Ontong Java Nui, which is has been subducted, and a rifted margin with a strong volcanic overprint at its southern edges towards the Hikurangi Plateau.

These observations allow us a re-examination of the conjugate margins of the Hikurangi Plateau and the Ontong Java Plateau. The repositioning of the different plateaus leads to the conclusion that Ontong Java Nui was larger (~1.2% of the Earth's surface at emplacement) than previously anticipated. We use these finding to improve the plate tectonic reconstruction of the Cretaceous Pacific and to illuminate the role of the LIPs within the plate tectonic circuit in the western and central Pacific.